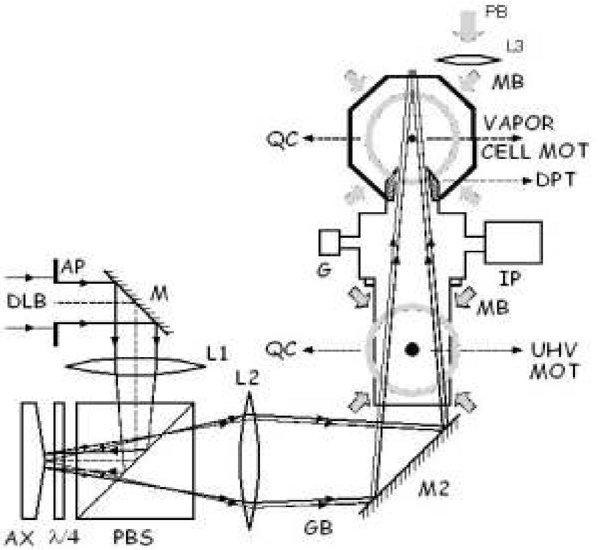

Fig.L.5.1. Schematic of the set-up to guide cold atoms from vapour cell MOT to UHV MOT. DLB: diode laser beam, AP: aperture, M & M_2: 45^o high reflectivity mirrors, AX: axicon mirror, $\lambda/4$: quarter wave plate, PBS: polarizing beam splitter, L_1: lens of 80 mm focal length, L_2: lens of 250 mm focal length & 75 mm diameter, L_3: lens of 300 mm focal length & 50 mm diameter, GB: guiding hollow beam, MB: MOT beams, PB: push beam, IP:sputter ion pump, G: gauge, QC: quadrupole coils, DPT: differential pumping tube.

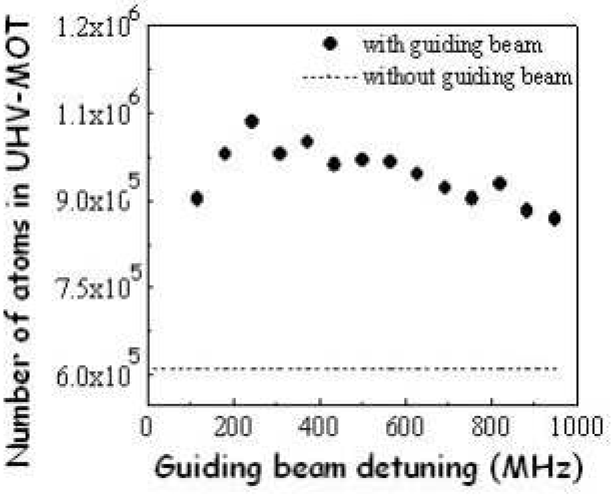

Fig. L.5.2. Variation of number of atoms in UHV-MOT with detuning of the guiding hollow beam from the cooling transition of Rb^{87}.

fluorescence imaging with a CCD camera. Loading of the UHV-MOT was found to depend on power of the push beam and the optimum power was found to be ~ 160 μW.

To enhance the number of atoms in UHV-MOT further, a blue-detuned hollow guiding beam was used to confine atoms in transverse direction while they are being transferred from vapor-cell MOT to UHV-MOT. This hollow guiding beam was generated using a metal axicon mirror *(Ref. RRCAT Newsletter Issue 2, 2006, p.5)* and focused using a lens combination. The hollow guiding beam (power ~ 33 mW) was blue-detuned from the cooling transition of Rb^{87} and the number of atoms in UHV-MOT was measured for different values of detuning of the guiding beam. As shown in the Fig.L.5.2, for a suitable detuning, around two-fold enhancement in the atom number was observed.

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L.6: In-vivo, non-invasive measurement of gradient refractive index profile of crystalline lens of fisheye

Crystalline lens of an eye plays an important role in visualization. The crystalline lens does the primary focusing for aquatic animals, as immersion renders cornea optically ineffective. The commonly employed techniques for measurement of gradient index profile are Abbe refractometer, interference technique, and laser ray tracing methods that require either sectioning or dissection of the lens. Magnetic resonance imaging (MRI) can be used for the non-invasive measurement of refractive index profile of fisheye lens. However, conventional MRI is not suitable for measuring the refractive index in the core region of the lens due to the absence of free water.

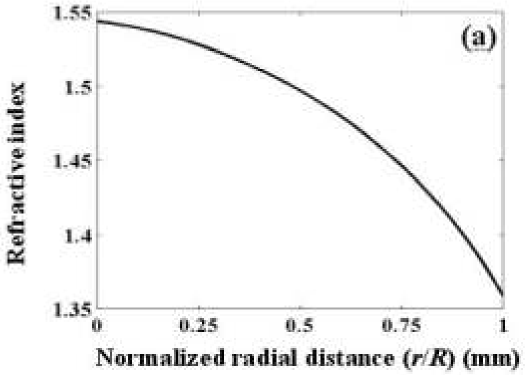

Fig.L.6.1: Refractive index profile obtained from the fitted mean values of coefficients using a polynomial refractive index model (R is radius of the lens).

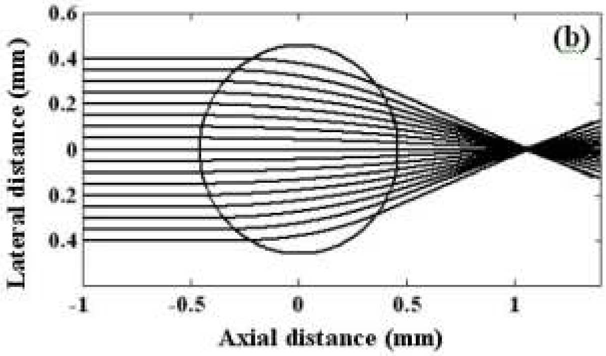

Fig.L.6.2: Ray paths for the refractive index profile shown in Fig.L.6.1

At Bio-Medical Applications and Instrumentation Division, use of Optical coherence tomography (OCT) was investigated for non-invasive measurement of gradient refractive index profile as axial scans in OCT give the optical path rather than the geometric path. The proposed method that retrieves the parameters of the polynomial form gradient refractive index profile by iterative fitting of optical path calculated by ray tracing method (Fig.L.6.1) with that experimentally measured using OCT. The approach has been employed for determining the index profile of fisheye lens in-vivo conditions (Fig.L.6.2). With suitable modification for the lens model, this method is expected to be applicable for determining the index profile of human lens also.

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L.7 : Multi-wavelength Fiber Bragg Grating writing using 255 nm radiation

In Laser System Engineering Division, a laboratory was set up for writing Fiber Bragg Grating (FBG) using second harmonic UV (255 nm) of copper vapour laser beams. Highly spatially coherent UV beams of average power up to 1 W were generated and utilized for writing the C-band FBGs up to 30 dB reflectivity *[Om Prakash et al. Optics Commun. 263, 65-70 (2006)]*. This work is further extended by writing multiple wavelengths FBGs (MWFBG) on a single mode optical fiber. These gratings are useful in many applications including distributed sensing and wavelength division multiplexing.

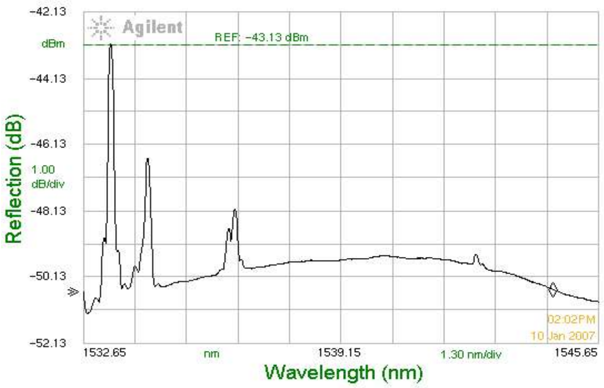

Fig.L.7.1: Multi-wavelength fiber Bragg grating written through a phase-mask

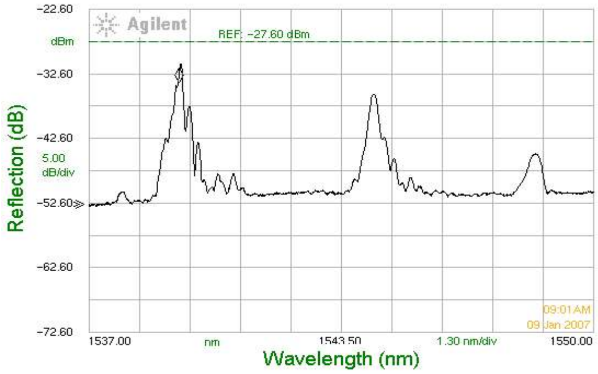

Fig.L.7.2 : Multi-wavelength fiber Bragg grating written through a bi-prism

Both, phase mask and bi-prism were used for writing these gratings. In the phase mask method, collimated UV beam is made to fall on the phase mask. MWFBGs were written by tilting the optical fiber in the grating writing plane. Each tilt produced tilted UV fringes of different spacing onto the fiber thereby leading to different Bragg wavelengths. In the bi-prism method, a geometrically diverging beam was made to fall on a 24° apex angle bi-prism. By placing the fiber, at a different location beyond the bi-prism, UV fringes of different spacing and hence the different Bragg wavelengths were obtained. Fig. L.7.1 (phase mask method) and Fig.L.7.2 (bi-prism method) show MWFBGs, written on a single mode optical fiber. These patterns were recorded by an optical spectrum analyzer.

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